Conceptual clarification about co-regulation of learning: An integrative review

Fernanda Cristina Ribeiro Faria, Daniela Cristina Pedrosa, Betina da Silva Lopes & Rodrigo Faria

Abstract

There has been a lack of conceptual clarification about co-regulation of learning (CRL). Moreover, the use of different terminologies (e.g., social shared regulation, collaborative learning, and shared learning) to refer to CRL is somewhat common, even though they are different concepts. An integrative review was conducted with a predominantly qualitative approach and an exploratory theoretical basis. The goal is to characterize CRL, providing conceptual clarity and understanding. A total of 56 papers that explicitly address the concept of CRL were analyzed and the characteristics of CRL were organized and then grouped according to their response to three guiding questions: What is CRL? How is CRL used? and Why is CRL used? A qualitative content analysis revealed 42 characteristics of CRL. Statistical significance tests were conducted and highlighted the 9 most relevant findings. This study contributes to a conceptual clarification of CRL by defining guidelines that might be useful to drive pedagogical practices and, in final instance, promote self-regulation of learning.

Keywords:

Co-Regulation of Learning; Co-Regulated Learning; Conceptualization.

Clarificação conceptual da Corregulação da Aprendizagem: Uma Revisão Integrativa

Resumo: Há uma falta de clarificação conceitual sobre a Corregulação da aprendizagem (CRA) e o uso de vários conceitos (e.g. regulação sócio partilhada, aprendizagem colaborativa e aprendizagem compartilhada) para se referir à CRA embora as concepções sejam diferentes. Realizou-se uma revisão integrativa de natureza predominantemente qualitativa e de caráter teórico exploratório, com objetivo de caracterizar a CRA oferecendo uma compreensão e clareza conceitual. Foram analisados 56 artigos que abordam explicitamente o conceito da CRA e as características da CRA foram agrupadas de acordo com a sua resposta para três questões norteadoras: O que é a CRA?; Como a CRA é utilizada?; e Por que a CRA é utilizada? Uma análise de conteúdo qualitativa revelou 42 características da CRA. Testes de significância estatística foram considerados e evidenciaram as 9 mais relevantes. Este estudo contribui para a clarificação conceptual da CRA, apontando diretrizes que podem orientar práticas pedagógicas e, em última instância, promover a autorregulação da aprendizagem.

Palavras-chave: Corregulação das aprendizagens; Aprendizagem corregulada; Conceitualização.

Co-régulation de l'Apprentissage : Clarification conceptuelle à travers une Revue Intégrative

Résumé: Il a été observé un manque de clarification conceptuelle sur la corégulation des apprentissages (CRA) et l'utilisation de différents concepts (par exemple, régulation socio-partagée, apprentissage collaboratif et apprentissage partagé) pour désigner la CRA, bien que les conceptions soient différentes. Une revue intégrative à dominante qualitative et de nature exploratoire théorique a été réalisée dans le but de caractériser la CRA, offrant une compréhension et une clarté conceptuelle. Un total de 56 articles abordant explicitement le concept de la CRA ont été cartographiés, et les caractéristiques ont été associées à trois axes directeurs : Qu'est-ce que la CRA? ; À quoi sert la CRA? ; et Pourquoi la CRA est-elle utilisée? L'analyse de contenu qualitative a révélé. 42 caractéristiques de la CRA, et des tests de signification statistique ont identifié les 9 plus pertinentes. L'étude a contribué à la clarification conceptuelle en définissant des lignes directrices pouvant guider les pratiques pédagogiques. Ces lignes directrices deviennent utiles pour développer des stratégies qui favorisent l'autorégulation de l'apprentissage.

Mots-clés: Corégulation des apprentissages; Apprentissage corégulé; Conceptualisation.

Corregulación del Aprendizaje: Clarificación Conceptual a Través de una Revisión Integrativa

Resumen: Se ha observado una falta de clarificación conceptual sobre la corregulación del aprendizaje (CRA) y el uso de diferentes conceptos (p. ej., regulación socio-compartida, aprendizaje colaborativo y aprendizaje compartido) para referirse a la CRA, aunque las concepciones sean diferentes. Se llevó a cabo una revisión integrativa de naturaleza predominantemente cualitativa y de carácter teórico exploratorio, con el objetivo de caracterizar la CRA y ofrecer una comprensión y claridad conceptual. Se mapean 56 artículos que abordan explícitamente el concepto de la CRA, y las características asociadas a tres ejes directores: ¿Qué es la CRA?; ¿Para qué sirve la CRA?; y ¿Por qué se utiliza la CRA? El análisis de contenido cualitativo reveló 42 características de la CRA, aplicándose pruebas de significancia estadística que señalaron las 9 más relevantes. El estudio contribuyó a la clarificación conceptual al definir pautas que pueden orientar las prácticas pedagógicas. Estas pautas resultan útiles para desarrollar estrategias que promuevan la autorregulación del aprendizaje.

Palabras clave: Corregulación de aprendizajes; Aprendizaje corregulado; Conceptualización.

1. Introduction

Research on education focused on student autonomy frequently approaches the student within the learning process. A growing number of studies explore social regulation modes (Schoor et al., 2015), including the co-regulation of learning (CRL). These studies have gained relevance, especially in understanding how regulation supported by others occurs (Hadwin et al., 2018).

1.1 Historical contextualization

Studies on regulated learning emerged from Bandura (1978), leading to discussions about self-regulated learning (SRL), and the first studies focused on CRL appeared about a decade later (Hadwin et al., 2011). Subsequently, studies on social shared regulated learning (SSRL) emerged in recent decades (e.g., Bransen et al., 2021; Panadero & Alonso-Tapia, 2014; Panadero & Järvelä, 2015).

Discussions on developing autonomy in the learning process have highlighted the importance of those concepts, as SRL competencies are essential for students to develop skills such as planning, monitoring, and evaluating, while controlling the cognitive, motivational and emotional aspects that directly affect outcomes (Hadwin et al., 2018; Zimmerman, 2013). SRL also considers the social nature of learning, as the development process is influenced by the individual's environment.

Some theories (e.g., sociocultural, sociocognitive, and socioconstructivist) emphasize the importance of external agents, such as teachers and peers, in shaping students' learning (Bransen et al., 2021). This makes sense because students often struggle with independent self-regulation (Winne et al., 2013) and require external support, which is understood as CRL.

1.2 Relationship between SRL, SSRL, and CRL

SRL is related to an individual's ability to self-regulate their own learning (Hadwin et al., 2018; Zimmerman, 2000), while CRL and SSRL are models of social regulation. CRL refers to the process in which an external agent (e.g., teacher, peer, instructional material) helps regulate a student's learning processes (Allal, 2020; Kaplan, 2018). SSRL, often confused with CRL, refers to collective co-regulation (Allal, 2020), which occurs in groups and collaborative environments (Panadero & Järvelä, 2015).

To master the regulation process and to overcome some regulatory dysfunctions, external forms of regulation play an important role in helping learners progressively internalize strategies (Zimmerman, 2000). In this sense, SRL, CRL and SSRL are interconnected by their common goal: to develop an individual's ability to manage their own learning autonomously. In other words, when students are unable to self-regulate

independently, CRL can support SRL. These two elements can be fostered through the collaborative practices enabled by SSRL.

Although CRL has gained prominence in research on regulated learning, the definition of the concept remains unclear and is often associated with SSRL, collaborative learning, and shared learning (Allal, 2011; Hadwin et al., 2018; Hadwin & Oshige, 2011), mainly because the concepts sometimes overlap (Motta et al., 2017). CRL and SRL are interconnected, and both address the regulation of an individual through a regulatory agent. Therefore, clarifying the guidelines and boundaries of each concept can provide better guidance for pedagogical practice.

In this context, this study focuses on CRL and aims to clarify this concept by identifying its main characteristics and providing support for pedagogical practice. The research question guiding this work was formulated using an adaptation of the PICo strategy (Stern et al., 2014; Toronto & Remington, 2020; see Materials and methods section), which is considered suitable for qualitative research when there is no need to compare results: *how do scientific studies conceptualize CRL?*

3. Materials and methods

This literature review adopts a predominantly qualitative and exploratory theoretical approach. We conduct an integrative review of the literature on the conceptualization of CRL, as this methodology provides flexibility in study selection while maintaining enough technical rigor (Mendes et al., 2008; Souza et al., 2010).

This review follows the 5 steps (Appendix 1) suggested by Oermann and Knafl (2021): problem identification; literature research; data evaluation; data analysis; and presentation of results.

3.1 Problem identification.

Despite the growing interest in social regulation (Schoor et al., 2015), studies explicitly conceptualizing CRL remain scarce, as most research focuses on SRL (Hadwin & Oshige, 2011). The lack of precision in conceptualizing CRL has resulted in the misuse of this concept in relation to associated concepts (Allal, 2011; Hadwin & Oshige, 2011), as well as in the competition of concepts (Hadwin et al., 2018). Therefore, understanding how the scientific community interprets CRL is a starting point for defining and characterizing the concept.

PICo strategy (Stern et al., 2014) represents an appropriate strategy for the objectives of this research, characterized as follows:

P = Population (Scientific studies);

I = Phenomenon of Interest (Concepts of CRL) and

Co = Context (Studies on CRL).

3.2 Literature Research

WoS, Scopus and ERIC were the primary databases for this review. The recorded details of each phase are described below and can be found in Appendix 1:

- Boolean expression

The expressions "co-regulation of learning" and "co-regulated learning" were indicated on the fields: abstract, title and keywords. The use of the connective "OR" was considered to include different nomenclatures present in the literature. We limited the search to scientific papers, due to the interest in researchers' conceptualization of CRL.

- Eligibility Criteria

The inclusion criteria were: (i) scientific papers, reviews and abstracts published in journals and conference proceedings; (ii) no temporal delimitation, aiming to achieve a greater number of studies; and (iii) studies published in English, Portuguese, or Spanish. Books and book chapters were not considered. Relevant papers, according to such criteria, were included, regardless of the publishing quality indicator.

- Screening

The first search was carried out in the WoS database, resulting in 48 eligible papers. The searches performed in the SCOPUS and ERIC databases resulted, respectively, in 15 and 5 papers meeting the eligibility criteria and were included in the final corpus of 68 selected papers. Papers included in more than one of these scientific databases were counted only once.

A floating reading procedure was performed within the 68 selected papers (48 from WoS, 15 from Scopus and 5 from ERIC), seeking to identify which of those studies are relevant to the goals of this review. The results from the floating reading indicated 12 papers (7 from WoS, 3 from Scopus and 2 from ERIC) should be excluded due to not conceptualizing CRL. The 56 remaining papers were considered for critical analysis, as described below.

3.3 Data evaluation

All 56 papers were fully read, and excerpts clarifying researchers' perspectives on CRL were collected and organized for further integrative qualitative content analysis.

3.4 Data analysis

- Content Analysis

Using *a posteriori* coding, qualitative content analysis was performed (Weber, 1990). 137 codes were extracted and categorized based on guiding questions: 1. What is CRL?; 2. How is CRL used?; and 3. Why is CRL used? (Author in citation). These

codes were refined into 42 final categories. WebQDA software (Sousa et al., 2019) supported the coding.

- Statistical Analysis

Statistical analysis, including non-parametric tests, was performed to identify the most relevant characteristics, according to the extracted codes about researchers' conceptualization of CRL. The occurrence (or not) of each characteristic in the text of each paper was considered an independent dichotomous variable (yes/no), depicting a suitable scenario for applying binomial tests (Howell, 2007) aiming to identify the most significant characteristics pointed out by the selected papers on this review. Binomial tests were performed at a significance level of 5%.

A comparative analysis was designed based on codes fully or partially responding to the three guiding questions (what, how, why). We noticed 28 papers (50%), presenting a complete conceptualization of CRL, specifying characteristics describing what is CRL as well as how and why it is used. These 28 papers compose our named "specific sample" whilst the total of 56 papers in this review is conveniently indicated as "general sample". Finally, both samples (specific and general) were strategically compared.

The criterion used to identify the most relevant characteristics is based on the recurrence of codes from the content analysis in this review. The NPC (Number of Papers mentioning each Characteristic) was registered. The events of NPC representing a percentage equal or greater than 50% are considered relevant characteristics to this review goal. Binomial tests were performed whereas observed NPC represents a percentage below 50%. The results from such tests are used as decision criteria for classifying relevant or non-relevant characteristics. The characteristics whose NPC is close to 50% within statistical significance level, in accordance with the results from binomial test, are classified as relevant.

The reasoning for setting 50% as a criterion for inclusion in the group of the most relevant characteristics rests on the fact that it is the same percentage of papers presenting a fully conceptualization of CRL. Data analyses, including binomial tests, were performed using the statistical software SPSS (v28).

4. Presentation of results

The results from the grouping process are organized by guiding questions

4.1 What is CRL?

The results for the first question are shown in Table 1 (cf. papers in Appendix 2).

Table 1
Group A - What is CRL?

CODING OF THE CHARACTERISTICS	NUMBER OF PAPERS
A1 - The action of regulating or coordinating one's learning or receiving help from others to learn. It means, holding on support/mediation/help of regulatory agents (such as teachers, peers, and materials) for learning	31
A2 - It involves the regulation of cognitive, metacognitive, and motivational aspects	29
A3 - A regulatory process that mutually affects each other because they are interconnected	20
A4 - It's influenced by both external and internal variables	17
A5 - It unfolds the concept of self-regulation by understanding the social dimension	11
A6 - The regulatory agent background can influence the regulatory process (both self- and co-regulatory)	15
A7 - A temporary/progressive process	8
A8 - Co-regulation depends on both the quality and quantity of interaction	6
A9 - A conscious and intentional process	4
A10 - In co-regulation, one of the members may assume a regulatory role	3
A11 - Effective self-regulation does not guarantee effective co-regulation	2
A12 - The goal of co-regulation may not necessarily be self-regulation	1
A13 - A process of scaffolding and engagement	1

CRL is understood as the help (mediation/support/influence/scaffolding/external support) from regulatory agents (teacher, colleague, material, etc.) to others to the learning process. It is a process of social regulation where the environment acts on an individual's learning.

The CRL is still considered broader than the SRL, precisely because it goes beyond the understanding of the "I" and considers the social dimension. It is also considered a temporary and progressive process of learning coordination and can be conscious and intentional with the aim of regulating or being regulated by someone. However, this process can be characterized as irregular because it depends on the instructive and guiding role of the regulatory agent.

CRL seeks to regulate aspects of SRL, involving the process of monitoring, controlling, and evaluating cognitive, behavioral, motivational, and emotional processes. This is because regulatory processes are interconnected, that is, regulation is not unilateral, it is bidirectional and reciprocal. The processes influence each other (positively or negatively). For example, the co-regulated subject can assume two roles in the regulation process: when explaining their position, they can also co-regulate others. However, the final goal of CRL may not be SRL as it is a cyclical process with continuous opportunities for regulation.

Because of the received influence, both internal variables (emotion, confidence, cognition, etc.) and external variables (motivation, support, environment, etc.) affect the regulation process. During the CRL process, one must consider the obstacles and facilitators (e.g., internalization of planning, decision-making, reflection) that may impact the interaction, as well as interdependent aspects such as scaffolding and motivation.

The regulatory learner's experience can influence the regulatory process. The greater the experience and capacity of the regulatory learner, the more effective the CRL will be. Similarly, regulatory unevenness and a lack of social experience can compromise co-regulation and are related to unregulated learning.

The quality and quantity of interactions between subjects can be directly linked to the execution of CRL, being considered from a low level (with little mental involvement, only sharing information and experience, depending on more experienced regulators) to a high level (with effective construction of knowledge and distribution of control of regulation and combination of knowledge among subjects). This difference occurs because the subject may be able to self-regulate but not co-regulate another person, demonstrating awareness of their own learning process without supporting the other.

4.2 How is CRL used?

The results for the second question are shown in Table 2 (cf. papers in Appendix 3).

Table 2
Group B - How is CRL used?

CODING OF THE CHARACTERISTICS	NUMBER OF PAPERS
B1 - Through co-construction of knowledge	22
B2 - It occurs through social interaction with regulatory agents (such as teachers, peers, and material)	19
B3 - It occurs through interaction with diverse sources of information	16
B4 - Through reflective evaluation/self-assessment/reflective scaffolding	6
B5 - Through negotiation of regulatory aspects	4
B6 - Through co-monitoring	5
B7 - Through feedback	4
B8 - Through co-planning	4
B9 - Through collaborative or cooperative learning	4
B10 - Through joint responsibility for learning	3
B11 - Facilitated when the interests, objectives, and goals are similar	3
B12 - Through peer assessment	3
B13 - Through questioning	3
B14 - Through co-reflection	2
B15 - By requesting clarifications	2
B16 - Encouraging socioemotional interactions and positive atmospheres	1
B17 - It can occur when the interests and needs between the regulatory agent and the regulated are different	1
B18 - Encourage a challenging and constructive environment	1
B19 - Require commitment and engagement of the regulated individual	1
B20 - Negative experiences in interaction discourage co-regulation	1
B21 - Through the transition from self-regulation to co-regulation	1

CRL occurs fundamentally through social interaction with regulatory agents such as teachers and classmates. It also can occur through interactivity with different sources of information, such as: instructional materials, didactic tests, adaptive computational tests or tools that aid regulation.

This is because the co-construction of knowledge occurs when individuals engage in social processes involving mutual sharing of ideas, experiences, tasks, objectives, difficulties, and problem-solving strategies. These interactions contribute to joint planning, decision-making, and strategic definitions aimed at regulating learning. Making the processes public can contribute to the CRL because the comparison helps in collective reflection and in SRL.

CRL is linked to the joint responsibility of those involved in learning and can be facilitated when interests (goals, skills, etc.) are shared, however, interests, expectations and objectives may differ between individuals.

For CRL to occur, it depends on the following environments: challenging ones, those that encourage collaborative learning, stimulate social-emotional interactions and have a positive atmosphere. It is important to note that CRL depends on the commitment and engagement of the individual being regulated and the lack of harmony in socio-emotional interactions, as well as negative experiences, can discourage CRL. Additionally, the individual can transfer the challenges encountered in SRL to CRL.

CRL is intricately linked to the SRL and involves the negotiation of regulatory aspects. Some of these aspects include the co-planning process, co-monitoring, co-evaluation and co-reflection.

Co-planning involves verbalizing and acting, with the goal of evaluating tasks, asking activating questions, planning actions, setting goals, deciding on the best strategy, thinking about execution challenges and ways to overcome them, all while fostering collaboration with others. However, for it to be possible, it is important to address regulation of aspects inherent to the SRL, such as the negotiation of meanings related to feedback, goal setting, action planning, inclusion of metacognitive elements, instructional design, etc.

Co-monitoring process comprises verbalizing and acting to monitor learning, seeking the necessary changes for regulation, controlling cognitive, emotional, and behavioral aspects of the agent to be regulated, and making use of strategies to support the learning of others.

The process involves monitoring the execution, comparing the planned with the executed, and controlling the aspects that affect this process. It also includes motivating, offering help, and encouraging people to ask for assistance.

This process can occur through a request for clarification from the student. Monitoring particularly involves questioning because the act of asking questions contributes to high-level CRL and stimulates the processes of reflection, explanation, and monitoring of the work.

For co-evaluation to contribute to CRL, it should prioritize reflective evaluation. Reflective assessment should ensure reciprocity; when offering feedback, there is a space for CRL because it allows dialogue between those who provide and those who receive feedback. Making use of formative peer assessment can support reflection.

Co-reflection involves verbalizing and acting to review the execution of the task, reflect on the learning situation, compare what was planned with what was accomplished, evaluate learning behaviors, and provide feedback to support regulation. That is, it involves sharing doubts, anxieties, achievements, questions, peer observation, discussions, modeling, and instructional tips to support reflection.

4.3 Why is CRL used?

The results for the third question are shown in Table 3 (cf. papers in Appendix 4).

Table 3
Group C - Why is CRL used?

CODING OF THE CHARACTERISTICS	NUMBER OF PAPERS
C1 - Promote self-regulatory capacity or learning regulation	28
C2 - Assist in the transition between stages of regulation	22
C3 - Promote dialogue, reflection, and monitoring	9
C4 - Provide resources for working with others	3
C5 - Provide scaffolding	1
C6 - Is essential in environments requiring greater supervision	1
C7 - Is useful for active learning	1
C8 - Assist in student self-confidence	1

CRL helps to promote self-regulatory capacity or the regulation of learning, because it is directed towards high-level processes. It improves the SRL, including the motivational, emotional, cognitive, and metacognitive aspects.

Thus, being interconnected with SRL, directly affects self-regulatory processes, promoting an environment of dialogue, monitoring, and reflection. This enables interaction, questioning, and evaluation, resulting in co-produced learning. This process makes it possible to raise awareness about the cognitive, motivational, emotional, and social aspects of team members to strategically support SRL.

The CRL also facilitates the transition between the stages of regulation and can switch between those involved (regulators and students). Regulation comprises

precisely the transition from one state regulated by another (CRL) to a state of regulating itself (SRL), fostering individual contributions to the regulation of the group as a whole (SSRL).

While CRL provides resources to work with others and support collaborative learning, this might be a reason for the confusion between the interpretation of CRL and collaborative learning.

CRL is also related to the concept of scaffolding in the sense of supporting someone's learning. Scaffolding in learning refers to the gradual withdrawal of support given to the students as they progress in learning. The concept became associated with CRL because it is a method of providing support to students, helping them develop their skills and assisting them in regulation. The provision of support is necessary, especially in environments with more dependent students.

CRL contributes to greater student involvement in their own learning, stimulating them to solve problems and, consequently, seek new knowledge. It also motivates them, making them feel capable of overcoming challenges in the learning process.

4.4 Relevant characteristics

We consider that it is essential to clearly define the most cited characteristics among the 42 identified for CRL, based on the analyzed papers. A statistical test (binomial test) was used to identify the most relevant characteristics.

To verify whether there was a significant difference between the papers that addressed at least one of the guiding questions (general sample - 56 papers) and papers that addressed the three guiding questions (specific sample - 28 papers), we applied a statistical test to each sample separately (Table 5).

Table 5
Statistical test for relevant characteristics

Characteristics	General Sample Observed proportion	Exact Sig (2-tailed)	Standardized test	Specific Sample Observed proportion	Exact Sig (2-tailed)	Standardized test
A1	0,55	0,504	0,668	0,79	0,004	2,835
A2	0,52	0,894	0,134	0,68	0,087	1,701
C1	0,50	1,000	0	0,64	0,185	1,323
B1	0,39	0,141	1,47	0,43	0,572	0,567
C2	0,39	0,142	1,47	0,57	0,572	0,567
B2	0,34	0,022	2,272	0,5	1	0
A3	0,36	0,044	2,004	0,36	0,185	1,323
A6	0,27	<0,001	3,341	0,32	0,087	1,701
B3	0,29	0,002	3,074	0,32	0,087	1,701

Results from the binomial test – 5% significance level

In the general sample (56 papers), 5 characteristics were identified as relevant (Table 6) whereas in the specific sample (28 papers) 9 relevant characteristics were identified, 5 of which overlap with those identified in the general sample, adding 4 new characteristics.

Table 6
Most significant characteristics of CRL

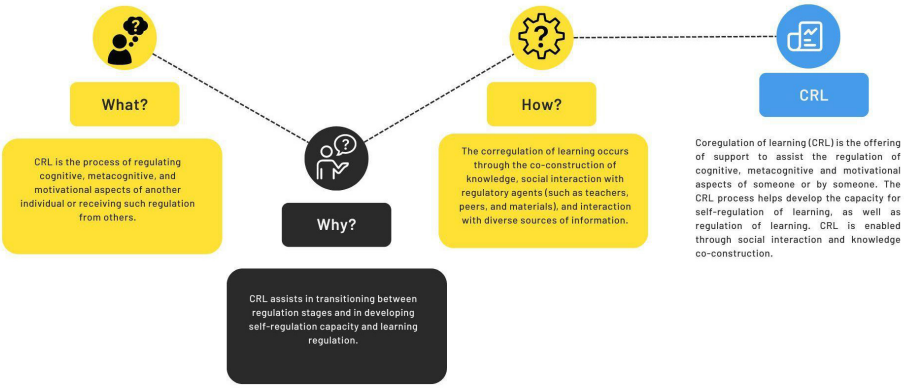
Group	Characteristic	General Sample	Specific Sample	Coding
What	AI	X	X	The action of regulating or coordinating one's learning or receiving help from others to learn. It means, holding on support/mediation/help of regulatory agents (such as teachers, peers, and materials) for learning
What	A2	X	X	Involves the regulation of cognitive, metacognitive, and motivational aspects
Why	C1	X	X	Promote self-regulatory capacity or learning regulation
How	B1	X	X	Through co-construction of knowledge
Why	C2	X	X	Assist in the transition between stages of regulation
How	B2		X	Occurs through social interaction with regulatory agents (such as teachers, peers, and material)
What	A3		X	A regulatory process that mutually affects each other because they are interconnected
What	A6		X	The regulatory agent background can influence the regulatory process (both self- and co-regulatory)
How	B3		X	It occurs through interaction with diverse sources of information

5. Discussion

5.1 Data Interpretation

In simple terms, the concept of CRL can be summarized as follows (Figure 1):

Figure 1
CRL conceptualization



From this analysis, it was deduced that CRL is an intermediate process between SRL and SSRL, confirming the arguments of Hadwin et al. (2018). It was also observed that CRL plays an essential role in the development of SRL, particularly for students with regulatory dysfunction, such as difficulties in the processes of planning, monitoring, and evaluating learning. This finding aligns with Zimmerman's (2000) idea that regulatory problems arise from a lack of social experience.

Overall, CRL can be understood as a progressive process of mediating and supporting the cognitive, metacognitive, behavioral, and emotional aspects of a student to help them achieve SRL.

5.2 Study limitations and suggestions for future research

Although this study contributed to conceptual clarification by providing clear guidelines for understanding CRL, it has some limitations, such as: considering scientific papers from only three databases, which may have limited the identification of relevant studies from other sources. Additionally, due to the research objective, the study has a theoretical bias. Future studies are encouraged to overcome these limitations and explore pedagogical practices that foster CRL.

6. Conclusion

The present study contributed to the conceptual clarification of CRL by identifying 42 characteristics associated with the concept, of which the 9 most relevant were highlighted through statistical tests. These characteristics were organized into three guiding axes: "What is CRL?", "How is CRL used?", and "Why is CRL used?". The review enabled a deeper understanding of the concept, as well as providing guidelines for pedagogical practice.

From a theoretical perspective, this study highlights the importance of CRL in supporting students who face regulatory challenges. To effectively promote CRL, it is essential to prioritize the co-construction of knowledge through the exchange of elements that may affect learning (thoughts, tips, experiences, strategies, ideas, goals, difficulties, solutions found, etc.). This form of regulation occurs through social interactions (with teachers and peers) that influence regulation, as well as in contexts beyond the classroom, including interactions with instructional materials, pedagogical resources, and regulation-supporting software, etc.

CRL aims to develop SRL skills and represents the transition process between regulatory phases. In other words, CRL is understood as a process of transitioning from being regulated by someone (usually, but not necessarily, a more experienced individual) or by something, to becoming self-regulated.

In terms of pedagogical practice, the identified characteristics can guide the implementation of CRL, particularly in educational contexts where the development of students' autonomy is a central goal.

Understanding the aspects involved in co-regulated learning enables the design of practices and learning environments that promote CRL.

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Fernanda Cristina Ribeiro Faria
Universidade de Aveiro
CIDTFF (Centro de Investigação em Didática e Tecnologia na Formação de Formadores)
Email: fcrfaria@ua.pt
ORCID: https://orcid.org/0000-0002-5694-8250

Daniela Cristina Pedrosa
Instituto Politécnico de Santarém
CIDTFF (Centro de Investigação em Didática e Tecnologia na Formação de Formadores); INESC TEC (Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência) e CIEQV (Centro de Investigação Em Qualidade de Vida)
Email: daniela.pedrosa@ese.ipsantarem.pt
ORCID: https://orcid.org/0000-0001-9536-4234

Betina da Silva Lopes
Universidade de Aveiro
CIDTFF (Centro de Investigação em Didática e Tecnologia na Formação de Formadores)
Email: blopes@ua.pt
ORCID: https://orcid.org/0000-0003-0669-1650

Rodrigo Faria
Universidade de Aveiro
Email: rfaria@ua.pt
ORCID: https://orcid.org/0000-0002-1705-1539

Correspondência
Fernanda Cristina Ribeiro Faria
Universidade de Aveiro, 3810-193 Aveiro

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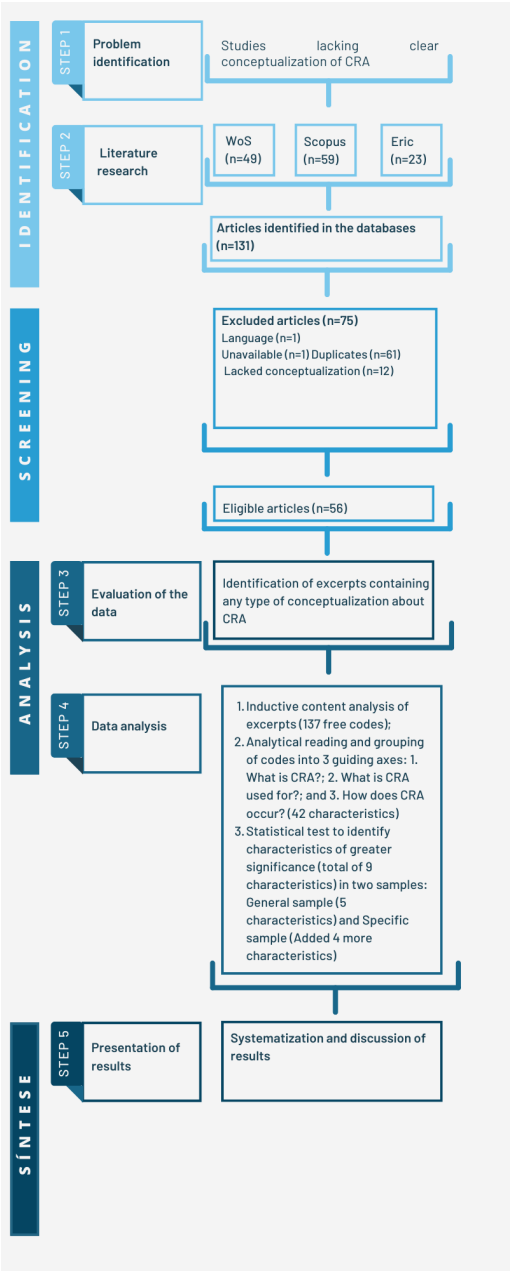
Appendix 1

5 steps of the literature review (Oermann & Knafl, 2021).



Appendix 2
Papers of Group A - What is CRL?

Coding of the characteristics	Papers
A1 - The action of regulating or coordinating one's learning or receiving help from others to learn. It means, holding on support/mediation/help of regulatory agents (such as teachers, peers, and materials) for learning	(Alemdag & Yildirim, 2022; Allal, 2011; Andrade et al., 2021; Andrade & Brookhart, 2019; Azevedo et al., 2002; Borge & White, 2016; Bransen et al., 2020, 2022; Chaker & Impedovo, 2021; Chan, 2012; Chen & Bonner, 2020; Çiloğlugil et al., 2020; Er, 2020; Harley et al., 2018; Lahdenperä et al., 2022; Motta et al., 2017; Panadero et al., 2019; Pedrosa et al., 2020; Räisänen et al., 2016; Rich, 2017; Saariaho et al., 2016, 2018, 2019; Shea et al., 2012; C. W. Tsai, 2015; C.-W. Tsai, 2015, 2016; Vandenberg et al., 2020; Wu et al., 2021; Yonder & Pandey, 2021; Zong, 2011)
A2 - It involves the regulation of cognitive, metacognitive, and motivational aspects	(Allal, 2011; Andrade et al., 2021; Andrade & Brookhart, 2019; Bransen, Driessen, et al., 2022; Bransen et al., 2019; Bransen, Govaerts, et al., 2022; Chaker & Impedovo, 2021; Chan, 2012; Chen & Bonner, 2020; Çiloğlugil et al., 2020; Harley et al., 2019; Kinshuk & Kumar, 2018; Motta et al., 2017; Olakanmi, 2010; Panadero et al., 2019; Pedrosa et al., 2020; Quackenbush & Bol, 2020; Räisänen et al., 2016; Rich, 2017; Roger et al., 2002; Saariaho et al., 2018, 2019; Shea et al., 2013; Silva et al., 2021; Tsai, 2015a, 2015b, 2016; Wu et al., 2021; Yonder & Pandey, 2021)
A3 - A regulatory process that mutually affects each other because they are interconnected	(Allal, 2011, 2020; Andrade et al., 2021; Andrade & Brookhart, 2019; Bransen, Driessen, et al., 2022; Bransen, Govaerts, et al., 2022; Chan, 2012; Çiloğlugil et al., 2020; N. C. DiDonato, 2013; Embo & Valcke, 2019; Harley et al., 2019; Matuga, 2005; Panadero et al., 2019; Rich, 2017; Shea et al., 2013; Tsai, 2015a, 2015c; Wu et al., 2021; Zhu & To, 2021; Zong, 2011)
A4 - It's influenced by both external and internal variables	(Allal, 2020; Andrade et al., 2021; Andrade & Brookhart, 2019; Bransen et al., 2019; Chan, 2012; Chen & Bonner, 2020; Clayton Bernard & Kermarrec, 2022; Costa, 2015; Matuga, 2005; Olakanmi, 2010; Panadero et al., 2019; Räisänen et al., 2016; Saariaho et al., 2018; Silva et al., 2021; Wu et al., 2021; Zhu & To, 2021; Zong, 2011)

Coding of the characteristics	Papers
A5 - It unfolds the concept of self-regulation by understanding the social dimension	(Andrade et al., 2021; Borge & White, 2016; Bransen, Driessen, et al., 2022; Chan, 2012; Matuga, 2005; Motta et al., 2017; Tsai, 2015a, 2015c, 2016; Wu et al., 2021; Zong, 2011)
A6 - The regulatory agent background can influence the regulatory process (both self- and co-regulatory)	(Allal, 2020; Bransen, Driessen, et al., 2022; Chen & Bonner, 2020; Er, 2020; Lahdenperä et al., 2022; Olakanmi, 2016; Panadero et al., 2019; Quackenbush & Bol, 2020; Rich, 2017; Saariaho et al., 2019; Silva et al., 2021; Tsai, 2015a, 2016; Wu et al., 2021; Yonder & Pandey, 2021)
A7 - A temporary/progressive process	(Allal, 2011; Chaker & Impedovo, 2021; Motta et al., 2017; Räisänen et al., 2016; Saariaho et al., 2016, 2019; Williams et al., 2017; Wu et al., 2021)
A8 - Co-regulation depends on both the quality and quantity of interaction	(Matuga, 2005; Motta et al., 2017; Quackenbush & Bol, 2020; Saariaho et al., 2016; Silva et al., 2021; Zong, 2011)
A9 - A conscious and intentional process	(Andrade et al., 2021; Saariaho et al., 2016, 2018, 2019)
A10 - In co-regulation, one of the members may assume a regulatory role	(Clayton Bernard & Kermarrec, 2022; Motta et al., 2017; Zong, 2011)

Coding of the characteristics	Papers
A11 - Effective self-regulation does not guarantee effective co-regulation	(Chan, 2012; Williams et al., 2017)
A12 - The goal of co-regulation may not necessarily be self-regulation	(Andrade et al., 2021)
A13 - A process of scaffolding and engagement	(Allal, 2011)

Appendix 3
Papers of Group B - How is CRL used?

Coding of the characteristics	Papers
B1 - Through co-construction of knowledge	(Allal, 2020; Azevedo et al., 2004; Carlson & Tannyhill, 2019; Chaker & Impedovo, 2021; Chan, 2012; N. DiDonato, 2011; Er, 2020; Finch & Willis, 2021; Hisatomi et al., 2019; Kinshuk & Kumar, 2018; Motta et al., 2017; Olakanmi, 2016; Quackenbush & Bol, 2020; Räisänen et al., 2016; Roger et al., 2002; Saariaho et al., 2019; Shea et al., 2013; Tsai, 2016; Vandenberg et al., 2020; Wang & Hong, 2018; Williams et al., 2017; Zong, 2011)
B2 - It occurs through social interaction with regulatory agents (such as teachers, peers, and material)	(Azevedo et al., 2004; Bransen et al., 2019; Bransen, Govaerts, et al., 2022; Chaker & Impedovo, 2021; Chan, 2012; Chen & Bonner, 2020; Clayton Bernard & Kermarrec, 2022; Costa, 2015; Embo & Valcke, 2019; Finch & Willis, 2021; Motta et al., 2017; Rich, 2017; Saariaho et al., 2019; Tsai, 2015c, 2015b, 2016; Wang & Hong, 2018; Yonder & Pandey, 2021; Zhu & To, 2021)
B3 - It occurs through interaction with diverse sources of information	(Alemdag & Yildirim, 2022; Allal, 2011, 2020; Andrade et al., 2021; Azevedo et al., 2004; Chen & Bonner, 2020; Costa, 2015; Finch & Willis, 2021; Harley et al., 2019; Hisatomi et al., 2019; Lahdenperä et al., 2022; Pedrosa et al., 2020; Quackenbush & Bol, 2020; Rich, 2017; Silva et al., 2021; Wang & Hong, 2018)
B4 - Through reflective evaluation/self-assessment/reflective scaffolding	(Allal, 2020; Andrade et al., 2021; Clayton Bernard & Kermarrec, 2022; Er, 2020; Peters et al., 2022; Silva et al., 2021)
B5 - Through negotiation of regulatory aspects	(Allal, 2020; Matuga, 2005; Peters et al., 2022; Quackenbush & Bol, 2020; Zhu & To, 2021)
B6 - Through co-monitoring	(Er, 2020; Kinshuk & Kumar, 2018; Olakanmi, 2010; Saariaho et al., 2016, 2019)
B7 - Through feedback	(Alemdag & Yildirim, 2022; Clayton Bernard & Kermarrec, 2022; Silva et al., 2021; Zhu & To, 2021)
B8 - Through co-planning	(Matuga, 2005; Olakanmi, 2010; Saariaho et al., 2016, 2019)
B9 - Through collaborative or cooperative learning	(Azevedo et al., 2004; Chan, 2012; Er, 2020; Motta et al., 2017)
B10 - Through joint responsibility for learning	(Peters et al., 2022; Räisänen et al., 2016; Shea et al., 2013
B11 - Facilitated when the interests, objectives, and goals are similar	(Kinshuk & Kumar, 2018; Räisänen et al., 2016; Shea et al., 2013)
B12 - Through peer assessment	(Alemdag & Yildirim, 2022; Allal, 2020; Clayton Bernard & Kermarrec, 2022)
B13 - Through questioning	(Matuga, 2005; Motta et al., 2017; Vandenberg et al., 2020)
B14 - Through co-reflection	(Olakanmi, 2010; Saariaho et al., 2016, 2019)
B15 - By requesting clarifications	(Carlson & Tannyhill, 2019; Zhu & To, 2021)
B16 - Encouraging socioemotional interactions and positive atmospheres	(Cerda et al., 2020; Räisänen et al., 2016)
B17 - It can occur when the interests and needs between the regulatory agent and the regulated are different	(Saariaho et al., 2019)
B18 - Encourage a challenging and constructive environment	(Shea et al., 2013)
B19 - Require commitment and engagement of the regulated individual	(Costa, 2015)
B20 - Negative experiences in interaction discourage co-regulation	(Motta et al., 2017)
B21 - Through the transition from self-regulation to co-regulation	(Carlson & Tannyhill, 2019)

Appendix 4
Papers of Group C - Why is CRL used?

Coding of the characteristics	Papers
C1 - Promote self-regulatory capacity or learning regulation	(Allal, 2011; Andrade et al., 2021; Andrade & Brookhart, 2019; Bransen, Driessen, et al., 2022; Bransen et al., 2019; Bransen, Govaerts, et al., 2022; Cerda et al., 2020; Chaker & Impedovo, 2021; Chan, 2012; Chen & Bonner, 2020; Çiloğlugil et al., 2020; N. C. DiDonato, 2013; Flynn et al., 2021; Harley et al., 2019; Olakanmi, 2016; Panadero et al., 2019; Pedrosa et al., 2020; Räisänen et al., 2016; Rich, 2017; Roger et al., 2002; Saariaho et al., 2016, 2018; Shea et al., 2013; Tsai, 2015a, 2015b, 2016; Wu et al., 2021; Yonder & Pandey, 2021)
C2 - Assist in the transition between stages of regulation	(Alemdag & Yildirim, 2022; Allal, 2011; Andrade et al., 2021; Andrade & Brookhart, 2019; Carlson & Tannyhill, 2019; Chaker & Impedovo, 2021; Chan, 2012; Clayton Bernard & Kermarrec, 2022; N. DiDonato, 2011; N. C. DiDonato, 2013; Embo & Valcke, 2019; Lahdenperä et al., 2022; Lin & Pryor, 2019; Motta et al., 2017; Rich, 2017; Saariaho et al., 2016, 2019; Tsai, 2015a, 2015b, 2016; Wu et al., 2021; Zhu & To, 2021)
C3 - Promote dialogue, reflection, and monitoring	(Andrade & Brookhart, 2019; Carlson & Tannyhill, 2019; Clayton Bernard & Kermarrec, 2022; Finch & Willis, 2021; Hisatomi et al., 2019; Olakanmi, 2016; Pedrosa et al., 2020; Saariaho et al., 2019; Wu et al., 2021)
C4 - Provide resources for working with others	(N. DiDonato, 2011; Er, 2020; Pedrosa et al., 2020)
C5 - Provide scaffolding	(Lahdenperä et al., 2022)
C6 - Is essential in environments requiring greater supervision	(Kinshuk & Kumar, 2018)
Coding of the characteristics	**Papers**
C7 - Is useful for active learning	(Saariaho et al., 2016)
C8 - Assist in student self-confidence	(Räisänen et al., 2016)

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